

**ABSTRACT**

Waveguides and backplanes systems are disclosed. A waveguide according to the present invention includes a first conductive channel, and a second conductive channel disposed generally parallel to the first channel. A gap is defined between the first and second channels that allows propagation along a waveguide axis of electromagnetic waves in a TE  $n,0$  mode, wherein  $n$  is an odd number, but suppresses electromagnetic waves in a TE  $m,0$  mode, wherein  $m$  is an even number. An NRD waveguide is disclosed that includes an upper conductive plate and a lower conductive plate, with a dielectric channel disposed between the conductive plates. A second channel is disposed adjacent to the dielectric channel between the conductive plates. The upper conductive plate has a gap above the dielectric channel that allows propagation along a waveguide axis of electromagnetic waves in an odd longitudinal magnetic mode, but suppresses electromagnetic waves in an even longitudinal magnetic mode. A backplane system according to the invention includes a substrate with a waveguide connected thereto. The backplane system includes at least one transmitter connected to the waveguide for sending an electrical signal along the waveguide, and at least one receiver connected to the waveguide for accepting the electrical signal.